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MOLDED RESISTOR WITH EMBEDDED TERMINALS

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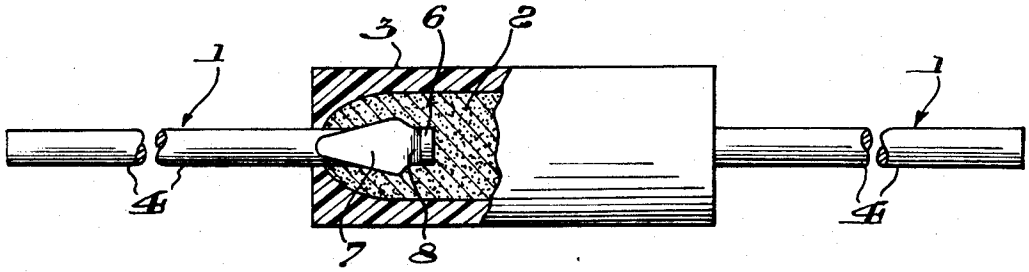


Fig. 1.

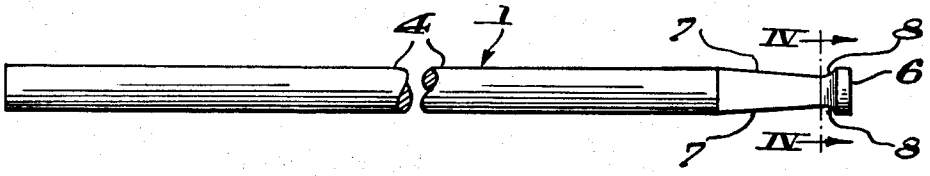


Fig. 2.



Fig. 3.

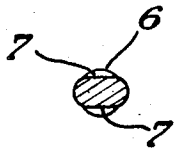


Fig. 4.

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3,411,124 MOLDED RESISTOR WITH EMBEDDED TERMINALS

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ABSTRACT OF THE DISCLOSURE

A molded resistance element has a pair of wire leads projecting from its opposite ends. The leads have a head embedded in the molded element.

Fixed composition resistors, in which wire leads have their ends embedded in elements molded from electrical resistance material, must pass several different tests in order to be capable of satisfactory use. These tests include electrical performance tests, electrical tests after certain mechanical tests, and tests directed to the ability of the resistors to be handled by automatic insertion and soldering equipment, which can be extremely rough on the resistors. Among the reasons that such resistors fail in these tests are loosening of the electrical connections between the wire leads and the resistance elements, breaking out of the ends of the resistance elements, overheating of the ends of the elements during the soldering operations, changes in value of the resistors or instability.

The leads of some resistors have a large mass of metal at the inner end to form a head. This large head reduces the volume of resistance material that can be molded around the head, whereby the resistance element is weakened at the ends. Also, the large head permits more leverage and therefore higher stress concentrations near the end of the resistance element. As a result, mechanical deformation of the lead will loosen it, either during pull and twist tests or during mechanical insertion in a circuit board. Other known resistors have used leads in which the inner end has been flattened to form a spade end, but such leads are easily loosened in the resistance elements or pulled out of them.

It is among the objects of this invention to provide a fixed resistor of the type just discussed, in which the cross sectional area of each wire lead is substantially equal from end to end of the lead, in which the leads are securely anchored in the molded element, in which the leads cannot be twisted in the element, in which the leads are easily formed, and in which the resistance element is strong at its ends.

In accordance with this invention, the portion of each wire lead embedded in a molded resistance element has a head of substantially the same cross sectional size and shape as the flexible body of the lead projecting from the element. The head is connected to the body by a neck having a pair of substantially flat sides that converge from the body toward the head in order to form a portion tapering in thickness, with its thin end connectetd to the head by a diverging portion much shorter than the tapered portion. The width of the tapered portion increases gradually from the flexible body inwardly to the thinnest part of the neck and then decreases rapidly to the head.

The preferred embodiment of the invention is shown in the accompanying drawing, in which

FIG. 1 is a side view of our resistor, partly broken away in section;

FIG. 2 is an enlarged side view of one of the lead wires of FIG. 1 rotated on its axis 90 degrees;

FIG. 3 is an end view of the head of the lead as shown in FIG. 2; and

FIG. 4 is a cross section taken on the line IV—IV of FIG. 2.

Referring to the drawing, suitable composition electrical resistance material is molded in conventional manner around the inner ends of a pair of axially spaced wire leads **1**. If desired, the resistance element **2** may be enclosed in a plastic case **3** molded around it. The leads project a considerable distance from the ends of the element, the projecting portion of each wire forming a flexible body **4**. For example, the leads may be made from wire that is approximately .032 inch in diameter, with all but about 0.1 inch of its length projecting from the resistance element.

It is a feature of this invention that the portion of each lead that is embedded in the resistant element has a head **6** of substantially the same cross sectional size and shape as the projecting body **4**, and is connected to the body by means of a neck. In fact, the head is the original inner end of the wire that remains after the neck is formed. The neck is formed by flattening a short length of the wire to taper it. Thus, the neck has a pair of substantially flat sides **7** which converge from the body toward the head as shown in FIG. 2. This forms a portion of the lead that tapers in thickness toward the head, to which it is connected by a diverging portion that is much shorter than the tapered portion. The sides **8** of the diverging portion have a slight curve, which may also be true of the sides of the tapered portion. In flattening the wire to form the neck, displaced metal is controlled in such a way that the width (as distinguished from the thickness) of the tapered portion increases gradually from the flexible body inwardly to the thinnest part of the neck and then decreases rapidly to the head, as shown in FIG. 1.

All surfaces of each neck are engaged by the resistance material forming the resistance element, whereby the wire leads are anchored in that element. In other words, the sides **7** and **8** of the neck form shallow recesses in opposite sides of the lead for receiving the molded resistance material. Since the diameter of the head is greater than the thickness of the neck, the head anchors the lead in the element. The outwardly sloping sides of the neck between its flat faces also help to anchor the lead in place. Flexing of the body of the lead will not loosen the lead in the element. The flattened neck has the further advantage of preventing the lead from being twisted in the element. Due to the fact that the diameter of the head is no greater than that of the body of the lead, sufficient material can be molded around the head to avoid breaking of the resistance element. Since the volume of the lead inside the resistance element is the same as if the wire had not been flattened, the thermal capacity of the lead is not increased and therefore will not absorb much heat during the soldering operation to change the characteristics of the resistor.

We claim:

1. In a fixed resistor comprising a molded resistance element having a pair of lead wires projecting from its ends with the projecting portion of each wire forming a flexible body of substantially uniform cross sectional size and shape throughout its length, the portion of each wire embedded in said element having a head of substantially the same cross sectional size and shape as said body and connected to the body by a neck, the neck having a pair of substantially flat opposite sides in the element several times longer than the head, said sides converging from the periphery of the body toward the head to form a por-

tion tapering in thickness from said body nearly to the head, the thin end of the tapered portion being connected to the head by a diverging portion much shorter than said tapered portion, and the width of said tapered portion increasing gradually from said body inwardly to the thinnest part of the neck and then decreasing rapidly to said head, all surfaces of the necks being engaged by said element to anchor the lead wires therein.

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